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INTRODUCTION.

This REVIEW treats generally the meteorological conditions of the United States and Canada for November, 1888, and is based upon reports of regular and voluntary observers of both countries.

On chart i the paths of the centres of six areas of low pressure are shown; the average number traced for November during the last fifteen years being 10.9.

The areas of high and low pressure are discussed under their respective headings. Descriptions of the storms that occurred over the north Atlantic Ocean are also given, and their approximate paths shown on chart i, on which also appear the limits of fog-belts west of the fortieth meridian. No ocean ice was reported during the month.

The severest disturbances on the north Atlantic occurred over mid-ocean from the 6th to the 12th, and off the coast of the United States from the 22d to the 27th, when very low barometric pressure and gales of hurricane force were reported. In the vicinity of the Banks of Newfoundland fog was less frequently reported, while to the westward of the fifty-fifth meridian its occurrence was more frequently noted than for the corresponding month of 1887.

Chart ii exhibits the distribution of mean atmospheric pressure and mean temperature for the month. The mean temperature corresponded with the normal in many parts of the country. The greatest departures above the normal occurred in the north-central states, and in Manitoba they exceeded 7°. The greatest departures below the normal were noted in the northern and southeastern Rocky Mountain slopes, where they amounted to more than 6° and 5°, respectively. At a number of stations in the interior, southern, and northeastern parts of the country the maximum temperatures were higher than for any preceding November during the periods of observation.

Chart iii exhibits normal and current temperature curves for selected stations.

The distribution of rainfall for November, 1888, is shown on chart iv, and the normal precipitation for eighteen years is exhibited on chart v.

The precipitation was above the normal from the Mississippi River westward to the Rocky Mountains, and in nearly all districts east of the Mississippi, the greatest excesses occurring in Florida, and in districts along the southwest border, where two or three times the usual November rainfall was measured. It was below the normal in the east Gulf states, and over the northern portions of the country from the upper Lake region to the Pacific coast, the most marked deficiencies occurring in the extreme northwest and on the northern slope of the Rocky Mountains, where less than one-half the usual amount fell.

Chart vi exhibits the depth of snow on the ground at the close of the month. Similar charts showing the depth of snow on the ground on the 15th and the last day of each of the winter months will be published in the REVIEW. In the current month the depth of snow on the 15th was insufficient to admit of charting. This chart also shows the limits of freezing temperature during the month.

A very heavy snow storm occurred in northern Kansas on the 9th, and heavy snow was reported in the lower Saint Lawrence valley during the night of the 8–9th.

Chart vii exhibits tracks of West Indian hurricanes along the coast of the United States, and chart viii shows the meteorological conditions which attended the severe storm of November 23d–28th.

Commencing with July, 1888, the meteorological means for stations of the Signal Service have been determined from observations taken twice daily at 8 a. m. and 8 p. m. (75th meridian time). These hours of observation have been permanently adopted to supersede the former system of tri-daily observations taken at eight-hour intervals.

In the preparation of this REVIEW the following data, received to December 20, 1888, have been used: the regular semi-daily weather-charts, containing data of simultaneous observations taken at 133 Signal Service stations and 23 Canadian stations, as telegraphed to this office; 177 monthly journals and 181 monthly means from the former and 23 monthly means from the latter; 423 monthly registers from voluntary observers; 82 monthly registers from United States Army post surgeons; marine records; international simultaneous observations; marine reports through the co-operation of the Hydrographic Office, United States Navy, and the "New York Herald Weather Service;" monthly weather reports from the local weather services of Alabama, Arkansas, Colorado, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, Nevada, New England, New Jersey, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, and Texas, and the Central Pacific Railway Company; trustworthy newspaper extracts, and special reports.

ATMOSPHERIC PRESSURE (expressed in inches and hundredths).

The distribution of mean atmospheric pressure for November, 1888, as determined from observations taken daily at 8 a. m. and 8 p. m. (75th meridian time), is shown on chart ii by isobars. On July 1, 1888, the tri-daily observations of the Signal Service were superseded by observations taken twice daily at the hours named. A protracted series of hourly observations has shown that the difference is almost inappreciable between the mean pressure obtained from two observations taken at these hours and that determined from tri-daily observations taken at eight-hour intervals.

The mean pressure for November, 1888, was highest within an area bounded by the isobar of 30.15, which extended from the middle Atlantic states westward to the middle eastern Rocky Mountain slope and thence northwestward to the head-

waters of the Missouri and the upper valley of the Columbia. The highest mean reading reported was 30.20, at Lamar, Mo. The mean pressure was lowest over southern California and the lower valley of the Colorado, where it fell below 30.00, and in the British Possessions north of Montana, where a reading of 30.00 was noted at Swift Current, N. W. Ter.

A comparison with the pressure chart for October, 1888, shows that a general increase in pressure occurred, except along a small portion of the middle Pacific coast, where there was a slight decrease. The increase was most marked over the Canadian Maritime Provinces, where it was more than .30 over the east-central part of New Brunswick. From this locality it became less marked southwestward along the Atlantic coast to southern Florida, where it amounted to but .01 at Jupiter and .02 at Key West. From New England westward to the Rocky Mountains the increase generally exceeded .15, while over a greater part of the country south of the fortieth parallel and east of the plateau regions of the Rocky Mountains, except in the south Atlantic and Gulf states, the increase varied from .10 to .15. The only decrease noted was .02 at Eureka, Cal.

As compared with the normal pressure for November, the mean barometer readings for the current month were above the normal, except over portions of the middle and south Atlantic states, the Gulf States, the middle Rocky Mountain region, and the Pacific slope. The departures above the normal were greatest in New Brunswick, where they exceeded .15, from whence they became gradually less marked southwestward to the thirty-fifth parallel and westward to the upper valley of the Columbia; in the upper Rio Grande valley, southern New Mexico, and southern Arizona, they exceeded .05. The departures below the normal were greatest in California, where they amounted to .09 at San Francisco and Sacramento, from whence they became less marked northward to Vancouver Island, eastward to western Wyoming and Colorado, and southward to lower California. At Norfolk, Va., along the south Atlantic coast, over the eastern and middle Gulf states, and along the coast of Texas, the departures below the normal were less than .05, except at Pensacola, Fla., where a deficiency of .06 was noted.

BAROMETRIC RANGES.

The monthly barometric ranges at the various Signal Service stations are given in the table of miscellaneous meteorological data. The ranges conformed to the general rule, that is they increased with the latitude and decreased slightly, though somewhat irregularly, with increasing longitude. Along the Atlantic coast the extreme ranges varied from .21 at Key West, Fla., to 1.55 at Block Island, R. I.; between the eighty-second and ninety-second meridians, .54 at Pensacola, Fla., to 1.15 at Alpena, Mich.; between the Mississippi River and the Rocky Mountains, .65 at Brownsville, Tex., to .98 at Poplar River, Mont.; in the plateau and Rocky Mountain regions, .48 at Fort Grant, Ariz., to .95 at Fort Custer and Fort Assinaboine, Mont.; on the Pacific coast., .41 at San Diego, Cal., to .74 at Port Angeles, Wash.

AREAS OF HIGH PRESSURE.

Six well-defined areas of high pressure were observed within the limits of the stations of observation during the month of November. The reports indicate that all of these areas of high pressure originated to the westward of the Rocky Mountains. Four were first observed on the north Pacific coast and two in the region north of Idaho. The general direction of movement was to the south of east while west of the Mississippi River, and afterwards to the north of east. The mean latitude of these areas was to the south of the average track of high areas for November, and the movement was rapid after leaving the Rocky Mountains.

I.—The month opened with this area of high pressure central to the west of Oregon. It passed rapidly to the southeast, following the area of low pressure which was moving northeastward over the Lakes, and by morning of the 3d covered the west Gulf states, where the direction of movement changed to the north of east. The pressure at the centre decreased as it approached the Mississippi Valley and increased as the area extended over the Atlantic coast, the highest barometric reading being observed at Nantucket on the morning of the 5th, when the centre was southeast of that station.

II.—This area of high pressure also approached the stations from the north Pacific and was central in Oregon on the morning of the 5th, when a trough of low pressure extended from Texas to Lake Huron, and high area number i extended from Florida to Nova Scotia. The track pursued by high area number ii was slightly to the north of, and almost parallel to, that of number i. It moved southeastward to Kansas and thence northeastward to the Saint Lawrence Valley. While covering the Rocky Mountains it extended from the lower Missouri valley westward to northern California. On the 6th it apparently separated, the principal portion of the area moving over the Lake region with increasing pressure at the centre, while the western portion remained over the northern plateau regions, and after being reinforced from the north formed the area of high pressure traced as number iii.

III.—This area was first observed in Oregon on the 8th. After advancing eastward to the Rocky Mountains it apparently moved westward to the vicinity of Salt Lake City, where it was central on the morning of the 9th. It moved slowly southeastward during the succeeding twenty-four hours, preceded by heavy snows and rains in the central valleys during the 8th and 9th. It extended over the southern portion of the United States during the 10th, 11th, and 12th, attended by slightly colder, fair weather. After reaching the east Gulf states it moved northeastward along the Atlantic coast with increasing pressure at the centre, the maximum pressure, 30.60, occurring at Albany, N. Y., on the morning of the 13th, at which time this area had increased and covered all that portion of the country east of the Mississippi. It apparently changed direction on the 13th, disappearing over the Atlantic on the 14th.

IV.—Number iv was first observed in the region to the north of Idaho on the morning of the 13th, where it remained almost stationary until the morning of the 15th, when it extended over the northern Rocky Mountain stations, being central near Fort Custer, Mont., where the pressure was 30.50 and the temperature —10°. It moved slowly eastward, covering the eastern slope of the Rocky Mountains on the 16th, the central valleys and Lake region on the 17th, and New England and Nova Scotia on the 18th, the pressure increasing rapidly as it approached the coast, the maximum barometric reading, 30.86, being observed at Halifax, N. S., at the p. m. observation of the 18th. The easterly movement continued on the 19th, on which date this high area disappeared to the eastward of Sydney, N. S.

V.—Number v was first observed north of Idaho on the 18th, and was the only high area of the month that passed eastward to the north of the stations of observation. The pressure apparently increased rapidly during its movement eastward to the centre of the continent, where the barometer reached 30.74 on the 19th. The pressure remained high, but decreased slightly as the area extended over the Lake region and Saint Lawrence Valley from the 20th to 22d, after which it increased, attaining a maximum of 30.82 at Rockliffe, Ont., on the afternoon of the 22d. It moved eastward over New England and Nova Scotia during the 23d and 24th, and while central over Nova Scotia this area extended over the entire region occupied by the stations of observation east of the Rocky Mountains while the severe tropical storm, described as low area number vi, was moving northward over the ocean east of Florida.

VI.—Number vi was central near the north Pacific coast on the morning of the 26th. It moved slowly eastward, inclining slightly to the north, during the 27th, 28th, and 29th, extending over the upper Missouri valley. After reaching Dakota it extended southward over the eastern slope of the Rocky Mountains, and covered the central valleys at the close of the

month. The pressure increased during the easterly movement until it reached the northern plateau region, where it attained a maximum of 30.48 at Spokane Falls, Wash., on the morning of the 28th. After passing to the east of the Rocky Mountains the pressure decreased to 30.22 at the 8 p. m. report of the 30th.

The following table exhibits, in a concise manner, some of the more prominent characteristics of the high areas:

No.	First observed.			Last observed.		Duration.	Velocity per h'r.	Highest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
		°	°	°	°	*Days.*	*Miles.*			*Inches.*
I	1	43	125	41	65	4.0	39.6	5	Nantucket, Mass	30.38
II	5	43	121	49	71	3.0	36.1	8	Quebec, Quebec	30.54
III	8	44	119	40	67	6.0	22.9	13	Albany, N. Y.	30.60
IV	13	53	115	45	60	5.5	25.8	18	Halifax, N. S.	30.86
V	18	52	117	50	59	8.0	15.1	22	Rockliffe, Ont.	30.82
VI	26	44	124	42	99	4.0	14.6	28	Spokane Falls, Wash.	30.48
							*		Mean	30.61

*Average rate of progress, 25.7 miles per hour.

AREAS OF LOW PRESSURE.

During the month of November six well-defined areas of low pressure appeared within the limits of the stations of observation. The tracks of the centres of these areas of low pressure will be found on chart i. They moved to the north of east, those originating to the westward in the Rocky Mountain region moving more easterly than those first observed near the Atlantic coast. A remarkable feature of the tracks of these areas is that as the month advanced the areas of low pressure developed more to the eastward, and the direction of movement became more northerly; those first observed moved eastward from the central Rocky Mountain region, and those following developed in the southwest, Gulf, or Lake region, and moved northeastward; while the last named and most severe storm of the month probably originated in the West Indies, and moved almost directly northward along the coast. Chart i indicates that while the conditions favoring the development of these storms varied in location, they all apparently progressed toward a common centre in the region of greatest storm frequency near the north Atlantic coast.

The following table exhibits the principal facts regarding these low areas:

No.	First observed.			Last observed.		Duration.	Velocity per h'r.	Lowest pressure.		
	Date.	Lat. N.	Long. W.	Lat. N.	Long. W.			Date.	Station.	Reading.
		°	°	°	°	*Days.*	*Miles.*			*Inches.*
I	31*	41	108	52	68	2.0	45.8	3	Anticosti, G. of St. Law'ce	29.38
Ia	31*	41	108	40	92	1.5	25.0	7	Bird Rocks, G. of St. L.	29.56
II	4	37	103	51	58	2.5	43.3	11	*Anticosti*, G. of St. L.	29.06
III	6	32	105	49	65	4.5	24.1	16	Bird Rocks, G. of St. L.	29.34
IV	14	28	87	48	62	2.0	43.8	20	Sydney, C. B. I.	29.60
V	18	41	87	47	60	1.5	41.7	27	Block Island, R. I.	28.91
VI	24	29	76	47	61	5.0	15.0		Mean	29.31

*October. Average rate of progress, 34.1 miles per hour.

I.—The month opened with an extended area of low pressure covering the eastern slope of the Rocky Mountains with two centres of disturbance, one in Colorado and the other in southeastern Dakota, while areas of high pressure covered the Atlantic and Pacific coasts. During the 1st the two centres moved eastward, that from Colorado passing to eastern Kansas and the more northerly disturbance covering northern Michigan, with strong southerly winds and general rains in the Lake region and upper Mississippi valley. During the 2d the southern portion of the disturbance was replaced by the high area from the westward, while the northern centre of disturbance moved northeastward to the Saint Lawrence Valley, the pressure decreasing as the centre approached the coast.

II.—Number ii was observed previous to the development of the disturbance traced as number i. A slight disturbance appeared in the Missouri Valley, and was apparently forced southward by an increase of pressure to the north. On the afternoon of the 4th a disturbance of slight energy appeared in southern Colorado with general snows in Wyoming, Colorado, and Utah. This disturbance moved rapidly to the northeastward with increasing energy and was followed by a sharp fall of temperature in the central valleys. The area of rain which attended this depression generally included the Northern States and portions of Kentucky, Tennessee, and Arkansas. It passed northeastward over the Lake region north of the Saint Lawrence River, and was last observed as central near the west coast of Newfoundland on the morning of the 7th.

III.—Number iii was probably central in western Texas on the afternoon of the 6th, when the barometric pressure was low over the entire Rocky Mountain region, and a well-defined depression covered Montana. During the following day the northern disturbance was replaced by an area of high pressure over the northern and central Rocky Mountain regions, while the southern disturbance moved eastward, attended by very heavy rains in the Gulf States and as far northward as Missouri. After reaching eastern Texas the direction changed to the northeast, and the centre of disturbance reached the lower Ohio valley on the afternoon of the 8th. Heavy rains continued in the central valleys during the 8th and 9th, and a cold wave extended over the eastern slope of the Rocky Mountains, causing heavy snows in eastern Kansas and freezing weather as far south as central Texas. The centre of disturbance was apparently retarded and drawn to the westward from the afternoon of the 8th until 8 a. m. of the 9th, and during the succeeding twelve hours it moved slowly northward. It was central in the valley of the Wabash on the afternoon of the 8th, and north of, and near, Saint Louis, on the morning of the 9th, and south of, and near, Davenport, Iowa, on the afternoon of the 9th, after which it moved northward over the Lake region and disappeared in the lower Saint Lawrence valley on the afternoon of the 11th. The storm increased in energy as it moved eastward, severe westerly gales occurring on the north Atlantic coast and in the Maritime Provinces as the centre passed to the eastward. The westerly gales continued in the Maritime Provinces until the 13th, but the centre of disturbance had passed to the eastward on the preceding day.

IV.—This area of low pressure was apparently central in the east Gulf, near Pensacola, Fla., on the morning of the 14th. It moved northeastward over the south Atlantic states, developing considerable energy along the coast, attended by heavy rains and severe gales during the 14th. These rains continued and extended along the entire coast as far north as Nova Scotia, and the storm attained its maximum energy while central near the coast of Massachusetts. It extended in area and became less severe while passing over the Maritime Provinces, although the minimum pressure, 29.34, was observed at Bird Rocks on the 16th, when the centre was near that station.

V.—This storm developed in the southern part of the upper lake region, where the pressure was relatively low, although the barometer read 30.18 in the region where the disturbance originated, and the pressure was below 30.00 in southern Texas at the same time. It passed eastward over the lower lake region and New England, the pressure decreasing .20. It was central on the coast of Maine on the afternoon of the 19th, the pressure at the centre being 30.00, while on the morning of the 20th it was located near Sydney, where the pressure had decreased from 30.34 to 29.60 in twelve hours. This rapid decrease of pressure over Nova Scotia and an increase of pressure along the New England coast during the same period was attended by strong northeasterly gales. This storm moved rapidly to the northeast after leaving the coast line and is traced as ocean storm number 9.

VI.—This low area caused along the middle Atlantic and New England coasts a succession of violent gales, which were not only the most severe of the month, but also among the most

notable in the records of the past eighteen years. The depression was a West Indies hurricane, of that type or class which spends itself over the ocean without passing over the land area of the United States. Hurricanes of this class are especially dangerous to shipping plying along the Atlantic coast, since these storms approach the coast from the southeastward, their coming heralded at first only by a slight decrease of barometric pressure along the immediate coast line. When stations of observations were maintained in the greater and lesser Antilles, the Signal Service had timely warning of the advent of these storms, but since the discontinuance of these important stations, the Service is left scant time in which to issue warnings after the first storm indications are detected. The marine reports between the 18th and 22d indicate that this disturbance existed as a West Indies hurricane, moving directly westward to the south of, and near, the 25th parallel, between the sixtieth and seventy-seventh meridians, west of Greenwich. Near the seventy-seventh meridian the course of movement changed to the northward, and during the 23d and 24th the regular telegraphic weather reports of the Signal Service suggested the presence of a severe storm off the coast of Florida. Although the centre of this storm passed northward, nearly parallel to, and about two hundred miles east of, the middle and south Atlantic coasts, until it reached the vicinity of Nantucket, Mass., timely warnings were issued to the coast stations. These warnings were based upon observations taken on the extreme western edge of the low area at stations within the limits of the United States, but the indications were of so feeble and uncertain character that, without the wide experience of the Indications Officer in dealing with storms of this class in previous years, they would have been neglected and unheeded.

Cautionary signals were displayed at the southern New England ports at 9.40 p. m. of the 23d, at which time they were changed from storm to cautionary owing to the dying out of a previous storm resulting from a high area to the northward, and they were continued as cautionary on the southern New England coast on account of the threatening conditions on the south Atlantic coast at that time. At 11.45 a. m. of the 24th cautionary northeast signals were changed to storm northeast on the North Carolina coast, and cautionary northeast hoisted at Norfolk, and the following message sent: "Brisk to high northeast winds indicated for the North Carolina coast." The storm was then apparently central some distance to the east of Florida. At 9.45 p. m. of the 24th cautionary northeast were changed to storm northeast at Narragansett section, Wood's Holl, and Wood's Holl section, and cautionary northeast hoisted at New Haven, New London, Newport section, Boston, and Boston section, and Sandy Hook, and cautionary northwest at Atlantic City, Breakwater, and Fort Monroe. Messages: "Storm central south of Hatteras, apparently moving northeastward, strong northeast winds are indicated for the southern New England coast." "Brisk to high northerly winds for the middle Atlantic coast." When these signals were ordered the winds were light on the New England coast from Boston northward. At 10.20 a. m. of the 25th cautionary northeast were changed to storm northeast at Boston, Boston section, and Sandy Hook. Message: "Storm central southeast of New England and off the middle Atlantic coast, moving northeast. Dangerous gales are indicated for the middle Atlantic and New England coasts to-day or to-night."

From the above it will be seen that New England was warned while the storm was central near the southern Florida coast. The accompanying charts show the position of the storm centre at 8 a. m., Washington time, from the 23d to the 28th, inclusive, and the accompanying extracts from the reports of Signal Service observers and marine reporters serve to show the severity of the storm and the loss of life and property. These reports indicate that the storm apparently attained its maximum energy when the centre was south of New England and east of New Jersey, and they also indicate that the storm centre moved slowly to the northward after reaching the latitude of Hatteras, N. C., increasing in energy until it passed the southern New England coast, when it filled up rapidly. It apparently changed direction to the eastward, and by the 29th it existed as a feeble disturbance north of Nova Scotia. The intensity of the storm was apparently increased by the advance of an area of decidedly high pressure over the Saint Lawrence Valley immediately to the north of the disturbance. This area of high pressure was moving slightly to the south of east in rear of an extended area of low pressure in the north Atlantic. The barometer continued to rise in the lower Saint Lawrence valley until the afternoon of the 25th, reaching 30.80 when this storm was central east of Norfolk, Va. The centre of the area of high pressure passed to the northeast of the storm centre, causing an unusual gradient in the northern quadrants of the storm which resulted in destructive gales, these gales continuing until the centre of disturbance reached the land, when, as is usually the case, the intensity of the storm diminished.

The following are abstracts of reports made by Signal Service observers relative to this storm:

Hatteras, N. C., 25th: the high wind which prevailed throughout the day attained a maximum velocity of sixty-six miles per hour from the north at 6.10 a. m. The gale caused some damage to shipping.

Norfolk, Va., 25–26th: a storm began on the 25th and continued throughout the following day; the maximum velocity of wind, fifty miles per hour from the northwest, occurring at 6.55 p. m., 26th. The storm was very destructive; telegraph lines were prostrated, vessels blown from their moorings, and much damage to other property resulted. The tide was very high, flooding the lower portion of the city.

Kitty Hawk, N. C., 24th: a severe northeast storm has continued without cessation since 7 a. m. of the 20th. The wind continued in northeast until 3 p. m. to-day, when it backed to the north and increased in force, blowing steadily at about sixty miles per hour.

Atlantic City, N. J., 26th: high northwest wind; barometer very low, falling to 28.96 at 2 p. m.; high tide caused much damage.

New York City, 25–26th: high northwest winds prevailed throughout the 25th and 26th; maximum velocity forty miles per hour, on the 26th. Numerous houses along the coast were carried away by the wind, and hotels were flooded. The Coney Island railway was seriously damaged by washouts. The damage in this vicinity will amount to millions of dollars.

New Haven, Conn., 25–27th: a northeasterly gale began at 12.30 a. m., 25th, and continued until noon of the 27th, attaining a maximum velocity of fifty-one miles per hour from the northeast at 10.20 p. m., 25th, the highest velocity ever recorded at this station; snow began at 8.40 a. m., and changed to sleet at 4.10 p. m., 25th, and changed to rain during the night following. The storm caused much damage to property; two houses were blown over, and the telephone and telegraph wires sustained severe injury.

Block Island, R. I., 24–27th: the storm which began at 6.30 a. m., 24th, continued until 11.50 a. m., 27th; maximum velocity, eighty-four miles per hour, occurred at 3.25 a. m., 26th. The storm was very destructive to telegraph lines, and caused some damage to shipping. The barometer reached a minimum of 28.91 at about noon, 27th.

Vineyard Haven, Mass., 24–27th: high easterly and northeasterly winds, accompained by heavy rains, at intervals, prevailed from 8 p. m., 24th, until 6.30 p. m., 27th. All boats in the harbor dragged anchors; smaller craft were torn from their moorings and driven ashore, and numerous wrecks are reported.

Wood's Holl, Mass., 25–27th: high northeasterly winds began at 8 p. m., 25th, and continued until the evening of the 27th; maximum velocity, forty-eight miles per hour, occurred at 2 p. m., 27th. Heavy rain fell at intervals. The telegraph wires sustained some injury.

Portland, Me., 25–27th: high northeasterly winds, accom-

panied by snow, sleet, and rain, prevailed during the 25th, 26th, and 27th; maximum velocity of wind, thirty-six miles per hour from the northeast, on the 26th.

Eastport, Me., 25–27th: high northeasterly winds began on the 25th and ended at 4.45 a. m., 27th, attaining a maximum velocity of sixty-four miles per hour from the northeast; the gale was accompanied by snow, sleet, and heavy rain; much damage was caused to fences and buildings.

Boston, Mass., 25–27th: the barometer fell steadily during the 25th, reading 29.88 at 8 p. m.; snow fell during a greater part of the day, changing to rain in the morning and evening. The wind at 8 a. m. was blowing twenty-eight miles per hour from the northeast, and had been as high as thirty-eight miles per hour from the northeast during the preceding night. From 8 a. m. it increased gradually in velocity to forty-two miles, and continued to blow from thirty-six to forty-two miles from the north and northeast throughout the day and evening. The local weather conditions were almost identical with those of the "great blizzard" of March 11–13th, 1888. On the 26th the barometer fell slowly to 29.45 at 8 p. m. The wind blew in violent gales all night, the maximum velocity being sixty miles from the northeast at 1.35 a. m. It then moderated slightly, and at 8 a. m. was blowing thirty-six miles from the northeast, after which it again increased and blew heavy gales all day, with a maximum velocity of forty-eight miles from the northeast and north. After 8 p. m. it moderated. Dense fog hung over the harbor at night, and the afternoon steamers delayed sailing on account of the violence of the storm and the thick weather.

The following reports by shipmasters refer to this storm: *

17th.—Captain Metzenthin, of the s. s. "Ascania," reports a storm from the 16th to 18th; wind shifted from ne. to sse.; highest force of wind, 11 to 12; lowest barometer, 29.81, at 4 p. m. of the 17th, in N. 25° 1′, W. 57° 46′.

20th.—Capt. S. de Felleria, of the s. s. "Auskaro," reports a gale during the 19th and 20th; wind shifted from ene. to nne. and n.; highest force of wind, 8; lowest barometer, 29.56, at 3.30 a. m. of the 20th, in N. 26° 45′, W. 66° 07′. Captain Spratly, of the s. s. "Mozart," reports a storm from the 17th to the 25th; wind shifted from nnw. to ne.; highest force, 10 to 11; lowest barometer, 29.75, at noon of the 20th, in N. 28° 28′, W. 67° 08′.

21st–22d.—Captain Catherine, of the s. s. "City of Augusta," reports a strong gale from ne. to n.; lowest barometer, 29.97, at 5 a. m. of the 20th, in N. 36° 20′, W. 75° 00′.

22d.—Captain Barber, of the s. s. "Tropic," reports a nnw. gale, of hurricane force, on the 22d; lowest barometer, 29.94, at noon, in N. 26° 6′, W. 80° 7′.

23d.—Captain Pearson, of the s. s. "Fort William," reports a whole n. to nw. gale on the 23d; lowest barometer, 29.71, at noon, in N. 27° 20′, 79° 25′. Captain Norton, of the s. s. "Fanita," reports a n. gale of hurricane force; lowest barometer, 29.55, at 7.50 p. m., off Frying Pan Shoals. Captain Henderson, of the s. s. "Colon," reports a violent gale, attaining force 11 on the 23d, on which date the lowest barometer, 29.40, occurred at 6 a. m., in N. 30° 06′, W. 74° 10′.

24th.—Captain Wallace, of the bk. "Monsita," reports a gale, attaining force 11, at noon of the 24th, in N. 32° 14′, W. 75° 29′; direction of wind at time of maximum velocity, wsw. Captain Stevens, of the s. s. "Manhattan," reports a gale attaining force 9 on the 24th; wind shifted from ne. to n.; lowest barometer, 29.94, at noon, in N. 29° 45′, W. 80° 22′. The gale commenced the day after leaving New York, November 22d, and lasted until noon of the 25th. The wind seemed to follow the trend of the coast from Hatteras to Jupiter, as it was dead aft all the time, blowing seventy-five or eighty miles per hour at times, with a very heavy, breaking sea, especially off Frying Pan and Romaine.

25th.—Captain Wilder, of the s. s. "City of San Antonio," reports a wnw. gale of force 10; lowest barometer, 29.06, at 5 p. m., in N. 36° 46′, W. 73° 54′. Captain Wass, of the schr. "Morancy," reports a nw. storm of force 11; lowest barometer, 29.01, at midnight, in N. 37° 27′, W. 73° 39′. Captain Boaz, of the s. s. "Wyanoke," reports a nne. storm on the 25th; lowest barometer, 28.96, at 4 p. m., off Hog Island, Va. Captain Daggett, of the s. s. "Chattahooche," reports a n. storm; lowest barometer, 29.11, at 4 a. m., twenty-five miles ene. from Cape Henry.

26th.—Captain Crosby, of the s. s. "Effective," reports: noon, in N. 38° 35′ W. 71° 49′, 1 a. m., wind ne., barometer, 28.80, strong gale and high increasing sea; 5 a. m., very heavy gale, ship headed bow to sea; noon, wind e., hard gale, barometer, 28.60; 5 p. m., wind nne., hard revolving gale, barometer, 28.20; midnight, wind w., barometer, 28.20. Captain Le Gallias, of the s. s. "Grecian," reports a nw. hurricane; lowest barometer, 28.74, at 9 a. m., in N. 38° 10′, W. 72° 45′. Captain McCarthy, of the pilot boat "J. F. Loubat," reports strong gales from the 23d to the 26th; lowest barometer, 28.80, at 10 a. m., of the 26th, in N. 38° 00′, W. 73° 50′. Captain Jenney, of the s. s. "Richmond," reports a nw. gale on the 26th; lowest barometer, 28.93, one hundred miles off Cape Henry. Capt. Andrew Jackson, of "Light Vessel No. 45," in N. 37° 57′, W. 75° 05′, reports a nnw. to nw. hurricane; lowest barometer, 29.42, at 5 p. m.

27th.—Captain Bussius, of the s. s. "Werra," reports a gale veering from ese. to s.; lowest barometer, 29.27, at 5 p. m., in N. 40° 33′, W. 71° 40′.

The following is a report by the Boston Chamber of Commerce, forwarded through the Signal Service observer at Boston, of vessels wrecked during this storm. The list does not include the names of vessels damaged or which went ashore and afterwards floated:

S. S. "Allentown." Barks "Alexander Campbell," "Hannah." Brigs "Wilhelmina," "Golconda," "Alice." Schooners "Amazon," "Abbie S. Emery," "Albert H. Cross," "Clara," "E. L. Higgins," "Elizabeth," "Ethel M. Davis," "Edward H. Norton" (fisherman), "Emma," "G. W. Rawley," "J. and J. Locke," "John Mettler" (fisherman), "Lena Breed," "Marshall O. Wells," "Nellie Florence" (fisherman), "Robert Dority," "Robert Ripley," "Sasanoa," "T. A. Lambert," "William McLean," "Mountain Fawn."

On chart vii will be found the tracks of the centres of some of the principal storms of similar character occurring between 1873 and 1888, which caused more or less damage to shipping of the United States, and which might, in a measure, have been prevented had this service had regular meteorological stations in the West Indies and Bermudas, and provision made for telegraphic communication with them during the stormy season. While a number of these storms passed along the Atlantic coast without producing severe gales at the coast stations, reliable reports from the Bermudas and West Indies might enable this service to warn vessels about to leave port of the existence of dangerous storms, and of their probable direction of movement. Two such storms occurred in August, 1887, one in August, 1886, and one in August, 1879. While the storms of August, 1881, and September, 1876, approached the south Atlantic coast from the West Indies they disappeared soon after their centres reached the continent.

Referring to the severe storm of August, 1873, which caused the loss of probably 600 lives and over 1,000 vessels, involving losses aggregating $3,500,000, and seriously crippling the fishing interests of the United States and Canada, the English Meteorological Office, in a report covering a history of this storm, states that "its existence was known on the 18th at Saint Thomas, a week before the damage was done on the American coast, and on the 21st the residents of Bermuda were fully aware of its existence and could have foretold its track. From both of these places warnings might have been sent to America if telegraphic communication had existed."

In August, 1886, a storm appeared to the eastward of the Barbadoes on the 15th, and thence passed westward over the Carribbean Sea to about N. 14°, W. 76°, and during the 22d passed northward over Cuba, in about W. 81°; it then moved northeastward along the course of the Gulf Stream to New-

* In reports of shipmasters, force of wind is given on scale of 0 to 12 (Beaufort scale).

foundland by the 28th. This storm was particularly severe, causing loss of life and destroying crops and property of immense aggregate value.

In August, 1887, two severe storms advanced northward from the West Indies. One apparently originated to the eastward of the Windward Islands and moved northwestward to about N. 22°, W. 63°, by the 16th; moving slightly north of west, the depression was central on the 19th off the east coast of southern Florida, whence it recurved northward and followed the course of the Gulf Stream until the 23d, on which date it was central in N. 50°, W. 31°. During the passage of this storm along the coast of the United States it was attended by hurricanes of exceptional violence. During this month the presence of a second storm was indicated to the eastward of the Windward Islands on the 19th; by the 20th the centre of depression had moved west-northwest to about N. 22°, W. 66°, whence it is traced to N. 26°, W. 76°, by the 21st. On this date south to west gales of hurricane force prevailed over the eastern portion of the Bahama Islands; in the vicinity of the thirtieth parallel fresh easterly gales were reported, while off the Florida coast strong northerly gales prevailed. During the 22d and 23d the storm recurved slowly northward, with a marked decrease in energy; by the 24th it had advanced to N. 32°, W. 76°, and during its northeast passage along the course of the Gulf Stream during the next two days it was attended by hurricanes of great violence.

By extending telegraphic communication with Bermuda and availing ourselves of that now existing in the West Indies it would become possible for this Service to greatly extend its usefulness to the shipping interests of the country, and with proper arrangements for the distribution of storm signals, warnings could be issued which in a single year might save from destruction property the value of which would exceed the cost of maintaining this Service for many years.

NORTH ATLANTIC STORMS FOR NOVEMBER, 1888 (pressure in inches and millimetres; wind-force by Beaufort scale).

The paths of the depressions that appeared over the north Atlantic Ocean during November, 1888, are shown on chart i. These paths have been determined from international simultaneous observations by captains of ocean steamships and sailing vessels, received through the co-operation of the Hydrographic Office, Navy Department, and the "New York Herald Weather Service."

Eleven depressions have been traced, of which six advanced north of east over or near Newfoundland; two first appeared northeast of the Windward Islands; and three apparently originated over mid-ocean near the fiftieth parallel. The depressions traced north of the forty-fifth parallel generally followed normal east-northeast to northeast tracks, the exceptions being numbers 1 and 6, which assumed southerly paths after having advanced to the vicinity of the thirtieth meridian. An important storm which moved westward north of the West Indies to the Bahamas is thence traced northward off the coast of the United States as a low area. A second storm of tropical origin moved from northeast of the Windward Islands and apparently dissipated west of the Azores. The severest disturbances of the month occurred over mid-ocean, from the 6th to the 12th, inclusive, attending depressions 2, 3, and 5, and off the coast of the United States from the 21st to the 27th, attending depression 8 (low area vi).

In November, 1887, fourteen depressions were traced, of which two were continuations of storms charted for October, 1887; three traversed the ocean from coast to coast; one first appeared east of the fifteenth meridian; five passed eastward over or to the northward of Newfoundland; one apparently originated south of Nova Scotia; and three were given probable paths northward from the sub-tropical region. The general direction of movement of the depressions was east-northeast, and their tracks were rather evenly distributed along and north of the trans-Atlantic routes.

In November, 1888, the depressions traced corresponded in number with the average for November during the past four years. Over mid-ocean along the trans-Atlantic routes the weather was generally stormy, except during the latter half of the third decade. In the vicinity of the British Isles there was a succession of heavy gales during the first half of the month, and from the 24th to the 30th, inclusive; while off the coast of the United States the month was characterized by the very destructive storms of the third decade. Considered as a whole, the weather over the north Atlantic during the month was seasonable, and the depressions, while possessing great energy, did not exceed in intensity those traced for November during preceding years.

In the following descriptions of the depressions traced positions are given in degrees, latitude and longitude, except in cases where from twenty-five to thirty-five minutes have been cited, when they are given in degrees and half degrees.

1.—This depression was apparently a continuation of number 11, traced for October, 1888, and was central on the 1st south of Greenland near the fifty-fifth parallel, whence it moved northeast to the thirtieth meridian by the 2d, where it assumed a southeast course and advanced to the southern extremity of Ireland by the 4th, after which it passed eastward over the continent of Europe. This depression was attended by moderate gales and exhibited lowest pressure on the 3d, when a reading of 29.44 (747.8) was reported at noon, Greenwich time.

2.—This depression was central over Newfoundland on the 4th, from whence it moved rapidly eastward, and is last located south of the British Isles under date of the 8th. This storm was attended throughout by fresh to strong gales, and closely followed the trans-Atlantic steamer routes over a greater part of the ocean. Subsequent to the 8th the storm centre apparently recurved to the northward under the influence of depression number 3 which occupied mid-ocean during the 8th and 9th.

3.—This depression (low area ii) passed along the southern coast of Newfoundland during the 7th, and by the 8th had advanced to about N. 52°, W. 40°, and thence moved northeast to the thirtieth meridian by the 10th, after which it disappeared north of the region of observation. This storm augmented in energy during its advance over the ocean, and on the 9th barometer readings ranging to 28.41 (721.6) were reported near its centre, and from the 8th to 10th, inclusive, gales attaining hurricane force were encountered over mid-ocean.

4.—This depression is first charted northeast of the Windward Islands under date of the 5th, and is thence traced northeast to about N. 35°, W. 45° by noon, Greenwich time, of the 8th, after which its course cannot be determined with reports at hand. The storm possessed great energy, and its advance was attended by violent gales.

5.—This depression was apparently a subsidiary development to depression number 3, and is first located in about N. 49°, W. 22°, under date of the 11th, when strong to whole gales and pressure falling below 29.00 (737) were reported. By the 12th the storm-centre had advanced to the westward of the British Isles, where minimum pressure falling below 28.50 (724), and strong to whole gales, were reported. Subsequent to the 12th the depression apparently recurved to the northward under the influence of depression number 6, which occupied the ocean to the westward.

6.—This depression (low area iii) advanced from the Gulf of Saint Lawrence over northern Newfoundland and at noon, Greenwich time, of the 12th was central in about N. 52°, W. 43°, and from thence moved east-northeast to the thirty-second meridian by the 13th, where it remained nearly sta-